opposite polarity, said discriminator circuit detects when steps in load current and steps in line voltage are out of phase for upstream caused transient events, and in phase for downstream caused transient events.

Remarks

In view of the above amendments and the following remarks, favorable reconsideration of the outstanding Restriction/Election Requirement is respectfully requested. Claims 1 - 55 remain in this application. Claims 1, 11, 41, 42, 43, 45, and 46 have been amended.

1. Election of Species Requirement

A. Analysis of Patentably Distinct Species

The Examiner asserts that there are three patentably distinct species of the claimed invention: the embodiment of Figure 1 and Figure 5 are purportedly drawn to Species I, the embodiment of Figure 6 and Figure 7 are purportedly drawn to species II, and the embodiment of Figure 8 is purportedly draw to Species III.

The Applicant points out that, in fact, there are only two patentably distinct species of the claimed invention. The first species of the invention includes a di/dt discriminator circuit that detects high frequency fluctuations in the line voltage waveform and the load current waveform. The di/dt discriminator takes the derivative of these waveforms to determine the instantaneous slope of the waveform. A high frequency fluctuation will, naturally, result in large absolute derivative values. The Applicant respectfully points out that the first high frequency detection species includes the embodiments of Figure 1, Figure 5, Figure 6, and Figure 7. Further, the Applicant draws the Examiners attention to a thorough comparison of Figure 1 and Figure 6. These diagrams are identical, with exception that Figure 6 provides gated hold circuitry disposed between the detectors and the microprocessor. The embodiment of Figure 6 and Figure 7 is an enhanced version of the embodiment of Figure 1 and Figure 5. The sample and hold circuitry lengthens the detection pulses, giving the microprocessor more time to detect the presence of the pulses. Support for this is provided on page 13, lines 26 – 31. "The gated switch upstream/downstream di/dt discrimination also allows the outputs... to be stored for a predetermined interval...so that the arc fault detector need not work at the

speed required to acquire the fast acting di/dt..." The "fast acting di/dt" refers to the high frequency detection functionality of the circuits.

The second species of the invention is shown in Figure 8. The second species of the invention includes a discriminator circuit that detects low frequency fluctuations in the line voltage waveform and the load current waveform. Support for this is found starting with the fifth line of the last paragraph on page 15, which states: "[t]he technique described below is an upstream/downstream discriminator which supports a low frequency arc fault detection method...such techniques look for variation of the amplitude of the current wave, variation of the area of the current wave, or variation of the interval of the current wave."

The generic arc fault protection device should include both high frequency and low frequency detection circuitry. High frequency arc faults typically occur when the branch circuit is coupled to a resistive load. Low frequency arc faults typically occur when the branch circuit is coupled to an inductive load.

B. Identification of Species and the Claims as originally filed.

Generic Claims: Claim 11, claim 41, claim 42, claim 43, claim 45, and claim 46 are generic claims. These claims are directed to "detecting fluctuations in load current." These fluctuations include high frequency fluctuations, and the low frequency fluctuations.

Independent claim 11 is a generic device claim. Claim 41 is a means plus function version of claim 11. Claim 42 is a method of the apparatus corresponding to claim 11. The claims depending from claim 11 recite both high frequency and low frequency detection subject matter. For example, claims 12 – 27 recite the high frequency detection subject matter. On the other hand, claims 28 – 30 recite low frequency detection subject matter.

Independent claim 43 is a device claim that explicitly recites the high frequency portion and the low frequency portion of the device.

Independent claim 45 is a method claim that recites high frequency detection steps and low frequency detection steps.

Independent claim 46 is a device claim that is meant to recite both the high frequency and the low frequency detection capabilities of the discriminator circuit.

Species I:

High frequency arc fault detection claims.

Claims 1 – 10: "circuit detects steps in a magnitude" See page 7, line 21, which states: "[w]hen a step in a line voltage occurs....." This example from the specification shows that the term steps refers to high frequency fluctuation detection.

Species II:

There are no independent claims drawn to Species II.

C. Identification of Species and the Amended Claims.

The amendment to claim 1 has the effect of making claim 1 a generic claim. The language now reads: "said discriminator circuit detects current fluctuations in at least one current characteristic of a load current and voltage fluctuations in at least one voltage characteristic of a line voltage." The at least one characteristic recited refers to both the high frequency arc fault phenomena and the low frequency phenomena described in the specification. Claim 1, claim 11, claim 41, and claim 42 were amended to harmonize the language used in these claims.

Claim 43 was amended to depend from claim 11. Note that claim 11, claim 41, and claim 43 are directed to "arc fault protection devices, protective of a branch circuit portion of a power line electrical distribution system and connected to a load." Amended claim 43 explicitly refers to both a frequency circuit and a low frequency circuit. Claim 45 was amended to depend from claim 42. Amended claim 45 explicitly refers to frequency detection steps and low frequency detection steps.

Claim 46 was amended to depend from generic claim 1. Note that claim 1 and claim 46 are both directed to an arc fault detector for a power line system. Amended claim 46 more clearly points out the subject matter of the invention, in that the detector is configured to detect arc faults when the load is inductive.

2. Conclusion

Based upon the above amendments, remarks, and papers of record, Applicant believes the pending claims of the above-captioned application have traversed the Election/Restriction requirement and are in allowable form and patentable over the prior art of record. Applicant respectfully requests reconsideration of the pending claims 1 - 55 and a prompt Notice of Allowance thereon.

Applicant believes that no extension of time is necessary to make this Response timely. Should Applicant be in error, Applicant respectfully requests that the Office grant such time extension pursuant to 37 C.F.R. § 1.136(a) as necessary to make this Response timely, and hereby authorizes the Office to charge any necessary fee or surcharge with respect to said time extension to the deposit account of the undersigned firm of attorneys, Deposit Account 50-0289.

Please direct any questions or comments to Daniel P. Malley at (607) 256-7307.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. An arc fault detector for a power line system, comprising an upstream/downstream discriminator circuit, wherein said discriminator circuit detects [when steps in a magnitude of a load current and steps in a magnitude of a line voltage are in phase for] current fluctuations in at least one current characteristic of a load current and voltage fluctuations in at least one voltage characteristic of a line voltage, said discriminator circuit detecting an upstream transient event[s] when said current fluctuations and said voltage fluctuations are in phase, and said discriminator circuit detecting a[out of phase for] downstream transient event[s]when said current fluctuations and said voltage fluctuations are out of phase.

11. An arc fault protection device, protective of a branch circuit portion of a power line electrical distribution system and connected to a load, comprising:

a first sensor for detecting current fluctuations in at least one current characteristic of load current;

a second sensor for detecting voltage fluctuations in at least one voltage characteristic of a line voltage; and

a discriminator for comparing the polarities of said voltage fluctuations and said current fluctuations[;], wherein said comparison indicates whether an arc fault or arc mimicking noise is located in said branch circuit portion or located in a remainder of said electrical distribution system based on the comparison of the polarities.

41. An arc fault protection device, protective of a branch circuit portion of an electrical distribution system and connected to a load, comprising:

means for detecting current fluctuations in at least one current characteristic of load current;

means for detecting voltage fluctuations in at least one voltage characteristic of a line voltage; and

means for comparing the polarities of said voltage fluctuations and said current fluctuations[;], wherein said comparison indicates whether an arc fault or arc mimicking noise is located in said branch circuit portion or located in a remainder of said electrical distribution system based on the comparison of the polarities.

42. A method for protecting a branch circuit portion of an electrical distribution system from an arc fault, said branch circuit portion being connected to a load, comprising the steps of:

detecting current fluctuations in at least one current characteristic of load current;

detecting voltage fluctuations in at least one voltage characteristic of a line voltage; and

comparing the polarities of said voltage fluctuations and said current fluctuations[;], wherein said comparison indicates whether an arc fault or arc mimicking noise is located in said branch circuit portion or located in a remainder of said electrical distribution system based on the comparison of the polarities.

43. [An]The arc fault protection device of claim 11, [protective of a branch circuit portion of an electrical distribution system and connected to a load,]further comprising:

a high frequency [portion which looks]detection circuit configured to detect the current fluctuations and the voltage fluctuations, the voltage fluctuations including [at] instantaneous changes on [a]the line voltage [wave], and the current fluctuations including instantaneous changes on the load[a] current [wave of said system, wherein a relationship between said instantaneous changes indicates whether a transient is upstream or downstream]; and

a low frequency [portion which looks]detection circuit configured to detect the current fluctuations and the voltage fluctuations, the current fluctuations and the voltage fluctuations including fluctuations in [a fundamental frequency of said system and for changes in] wave amplitudes, wave areas, intervals of the waves, and/or a plurality of harmonics of said fundamental frequency[, wherein a sudden increase in said voltage wave accompanied by a sudden increase in said current wave indicates that said transient is upstream, and wherein a sudden increase in said voltage wave not accompanied by a sudden increase in said current wave indicates that said transient is downstream].

45. The method [for protecting a branch circuit portion of an electrical distribution system from an arc fault, said branch circuit portion being connected to a load] of claim 42, further comprising the steps of:

high frequency filtering a voltage wave and a current wave of said system;

determining whether a relationship exists between instantaneous changes on said high frequency filtered voltage wave and said high frequency filtered current wave of said system, and if so, whether said relationship indicates whether a transient is upstream or downstream;

low frequency filtering said voltage wave and said current wave of said system; and

determining whether [a change in a fundamental frequency of said system] fluctuations in wave amplitudes, wave areas, intervals of waves, and/or a change in a plurality of harmonics of said fundamental frequency occur, wherein [a sudden increase]fluctuations in said low frequency filtered voltage wave [accompanied by a sudden increase]in phase with fluctuations in said low frequency filtered current wave indicate[s] that said transient is upstream, and wherein [a sudden increase]fluctuations in said low frequency filtered voltage wave [not accompanied by a sudden increase]out of phase with said fluctuations in said low frequency filtered current wave indicates that said transient is downstream.

46. [An]The arc fault detector of claim 1, wherein said [for a power line system, comprising:

an] upstream/downstream discriminator circuit[;] is configured to detect arc faults when said detector is coupled to a inductive load such that[

wherein] during intervals when a line voltage and a line current are of a same polarity, said discriminator circuit detects when steps in load current and steps in line voltage are in phase for upstream caused transient events, and out of phase for downstream caused transient events[;], and[

]wherein during intervals when said line voltage and said line current are of opposite polarity, said discriminator circuit detects when steps in load current and steps in line voltage are out of phase for upstream caused transient events, and in phase for downstream caused transient events.